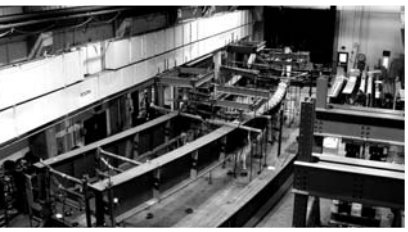



STRUCTURES LABORATORY FACT SHEET

Research that is Essential, Indispensable, and Connected to our Customers

The nearly 600,000 bridges on the National Highway System are vital to our Nation's mobility. The Structures Laboratory (Lab) at the Federal Highway Administration (FHWA) Turner-Fairbank Highway Research Center is a unique facility that specializes in developing and testing innovative bridge designs, materials, and construction processes that promise more efficient and durable bridges into the future.

PURPOSE

The primary mission of the Structures Lab is to conduct experimental studies to determine the behavior of bridge systems under typical and extreme conditions. Data from these studies help improve the national bridge design specifications and the safety, reliability, and cost-effectiveness of bridge construction in the United States. The lab tests bridge systems to enhance bridge durability and constructability over time. This work supports FHWA's strategic focus on improved mobility. The lab also investigates structural failures that occur in service to determine the cause of failure and develop practices and procedures that will prevent similar failures anywhere in the Nation.

DESCRIPTION

The Structures Lab is a world-class facility optimized for large-scale, indoor testing of bridge structures and components. The main lab is uniquely designed to erect full-scale bridges indoors and to test them using the latest technology. Everything from small specimens to full-size bridges can be subjected to simulated truckloads to evaluate strength and performance. This lab can evaluate the strength and mechanical properties of structural materials and can instrument and perform field evaluations of in-service bridge structures. These characteristics and the following capabilities make this lab uniquely suited for large, multiyear efforts involving pooled funding from States and industry:

- Fundamental research into the strength and safety of bridge structures and components.
- Fundamental research into the fatigue-resistance of structures under truck loading.
- Applied research to assess the suitability for service of various structural components and systems.
- Field evaluation of in-service structures.
- Forensic evaluation service of structural failures.
- Systems integration at super- and substructure interfaces.

MAJOR COMPONENTS

- 55.2- by 15.5-meter (m) (181- by 51-foot (ft)) indoor "strong floor" with a grid of 573 hold-down locations.
- 12.2- by 3.6-m (40- by 12-ft) indoor strong floor (shared with the Nondestructive Evaluation Validation Center).
- Two universal load frames (454,000-kilogram (kg) (1,000,000-pound (lb)) static load capacity, 199,760-kg (440,000-lb) dynamic load capacity).
- Indoor cranes, forklifts, and rigging equipment (18-megagram (20-ton) capacity).
- Numerous static load actuators (4,540- to 454,000-kg (10,000- to 1,000,000-lb) capacity).
- Numerous dynamic load actuators (4,540- to 99,880-kg (10,000- to 220,000-lb) capacity).
- Numerous instruments to measure load, displacement, rotation, and strain in structures.
- State-of-the-art computerized data acquisition (1,500-channel capacity).
- Laser displacement measuring system to measure structural response in three dimensions.
- Structural material testing room with three mechanical testing and simulation servo-hydraulic load frames, Charpy Vee-Notch tester, two hardness testers, and a drop tower.
- Metallurgical testing room, including microscopes and testing equipment.
- Portable telemetric data acquisition systems for field instrumentation of structures.
- Computers, UNIX® workstations, and software to perform advanced, nonlinear finite-element modeling of structural behavior.

The Turner-Fairbank Highway Research Center (TFHRC) has more than 24 laboratories for research in the following areas: safety; operations, including intelligent transportation systems; materials technology; pavements; structures; and human centered systems. The expertise of TFHRC scientists and engineers covers more than 20 transportation-related disciplines. These laboratories are a vital resource for advancing this body of knowledge created and nurtured by our researchers. The Federal Highway Administration's Office of Research, Development, and Technology operates and manages TFHRC to conduct innovative research to provide solutions to transportation problems both nationwide and internationally. TFHRC is located in McLean, VA. Information on TFHRC is available on the Web at ***www.tfhrc.gov****.*

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This RD&T fact sheet provides concise information about a TFHRC facility.

- Outdoor 7.6- by 9.2-m (25- by 30-ft) strong floor.
- Permanent, 21.35-m (70-ft) single-span, geosynthetic reinforced soil test abutments.

ACCOMPLISHMENTS

Recent Activities

- Developed improved specifications for designing and analyzing horizontally curved steel bridge structures. The Structures Lab provided the experimental data and analyses to support the American Association of State Highway and Transportation Officials' (AASHTO) development of the new Load and Resistance Factor Design Curved Girder Specification.
- Developed retrofit methodology to protect structures from the type of fracture failure identified in the Hoan Bridge in Wisconsin.
- Developed fatigue specifications to allow using powder-actuated fasteners to attach concrete forms to steel bridge girders.
- Helped develop AASHTO autostress design procedures to reduce the cost of steel bridges.
- Developed new equations for the safe design of prestressed concrete bridge girders and slabs.
- Helped develop new fatigue design procedures in the AASHTO specifications to ensure adequate service life of steel bridges.
- Verified the load-carrying capacity of a new lightweight aluminum bridge deck system.
- Demonstrated the feasibility of using fiber-reinforced plastics (FRP) to repair damaged concrete bridges.
- Evaluated the performance of FRP concrete reinforcement systems.
- Helped develop and test a new lightweight FRP bridge deck system.
- Assisted States and FHWA divisions with field evaluation of special problems in structures—e.g., Hoan Bridge fracture failure in Wisconsin, U.S. Interstate 664 in Hampton Roads, VA, Case Bridge in Washington, DC, and the Woodrow Wilson Bridge between Maryland and Virginia.
- Helped the National Transportation Safety Board investigate the collapse of the Fowler Bridge in New York.

Current Activities

- Evaluating ultrahigh-performance concrete bridge girders. These are the first full-scale tests of this new super-strength material to study how it can improve bridge performance.
- Developing design rules that allow full use of high-performance steels (HPS) and improve the efficiency of steel bridge design.
- Providing technical assistance to various State departments of transportation and AASHTO committees that support study and implementation of new bridge materials and designs.

Future Activities

Researchers in the Structures Lab will continue work to understand the detailed benefits and effects of the new generation of structural materials applied to bridges. The primary focus of the Structures research program will be to define and evaluate candidates for the Bridge of the Future—a bridge that is much more durable and more easily fabricated and constructed than are current bridges. These efforts will concentrate on bridge systems, from the foundations to the parapets, rather than individual bridge components. The Structures Lab is uniquely suited to perform this work because of the staff's broad expertise and the facility's design, which accommodates full-scale structural testing in a controlled environment.

PARTNERS AND CUSTOMERS

The Structures Lab continually partners with other research institutions, AASHTO, individual States, and industry organizations to reduce cost and promote implementation of research results.

- The curved girder bridge study is a major partnership involving AASHTO (a 26-State pooled fund effort), the National Cooperative Highway Research Program (NCHRP) (parallel NCHRP project 12-52 to develop a new bridge code), the American Iron and Steel Institute (AISI), and the National Steel Bridge Alliance (NSBA).
- The HPS fatigue and fracture study is being performed in partnership with the U.S. Navy and AISI, and directly supports FHWA's Innovative Bridge Research and Construction Program.

Past partners include:

- Industry organizations (American Concrete Institute, AISI, American Institute for Steel Bridge Construction, and the NSBA).
- Research institutions (Catholic University, California State University-Long Beach, George Washington University, Georgia Tech, Lehigh University, University of Maryland, University of Nebraska-Lincoln, and the Virginia Transportation Research Council).
- State departments of transportation (Colorado, Iowa, Nebraska, New York, Tennessee, Virginia, and Wisconsin).